AAM Ecosystem Working Groups (AEWG):

Urban Air Mobility (UAM) Concept of Operations (ConOps) Overview

Feedback

July 16th, 2020

3:00pm-4:30pm EDT

The UAM vision will only prove useful with buy-in and engagement from across the ecosystem

National Aeronautics and Space Administration

Agenda

July 16th, 2020

3:00pm-4:30pm

Topic	Content	Presenters	Timing	Duration
Welcome **UAM ConOps Overview Recap**	Introductions Brief review to spur conversation	Misty Davies Michael Patterson Jim Murphy	3:00-3:10	0:10
Session Engagement Ground Rules	How we will handle feedback from 100 over the next 60 or so minutes.	Misty Davies	3:10-3:15	0:05
Feedback from the Audience	Open mic Questions from chat Questions from original ConOps overview session	N/A	3:15-4:30	1:15

Speakers

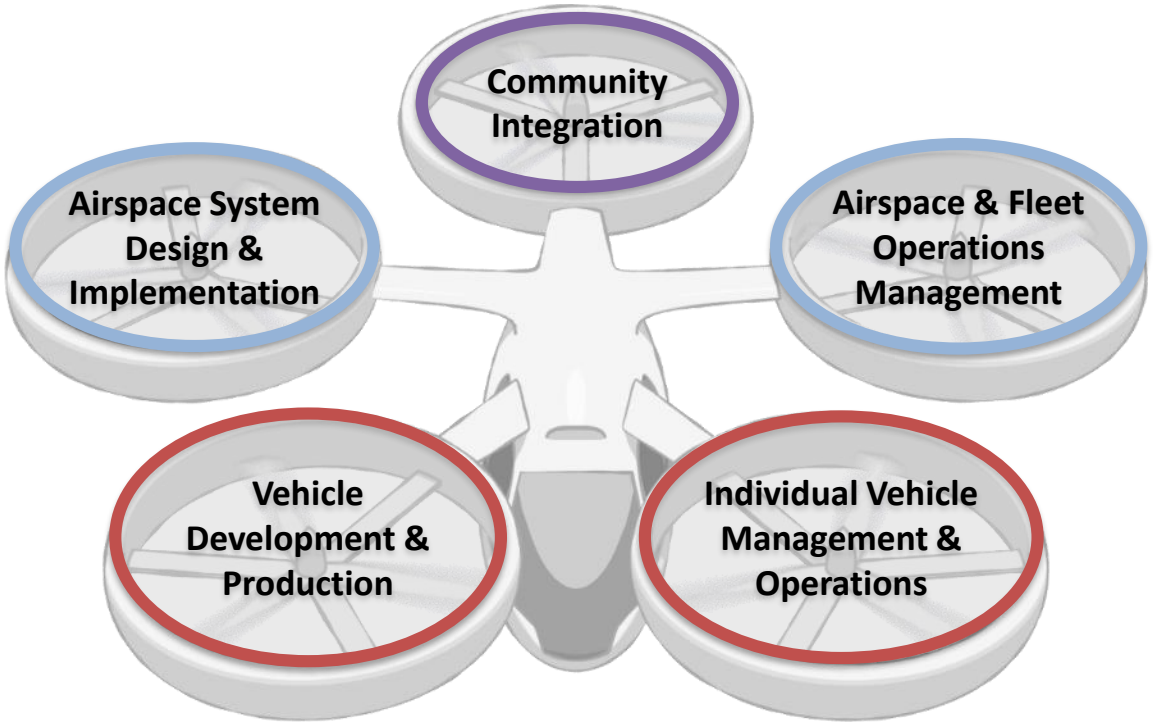
Dr. Misty Davies, National Aeronautical and Space Administration (NASA)
System Wide Safety Deputy Project Manager, NASA Ames Research Center
AAM Ecosystems Crosscutting Working Group Lead

Dr. Michael Patterson, National Aeronautical and Space Administration (NASA)
Aerospace Technologist, NASA Langley Research Center

Jim Murphy, National Aeronautical and Space Administration (NASA)
Integration Manager, NASA Ames Research Center

Nancy Mendonca, National Aeronautical and Space Administration (NASA)
Deputy Team Lead, UAM Coordination and Assessment Team (UCAT), NASA COR

Urban Air Mobility Community Concept of Operations



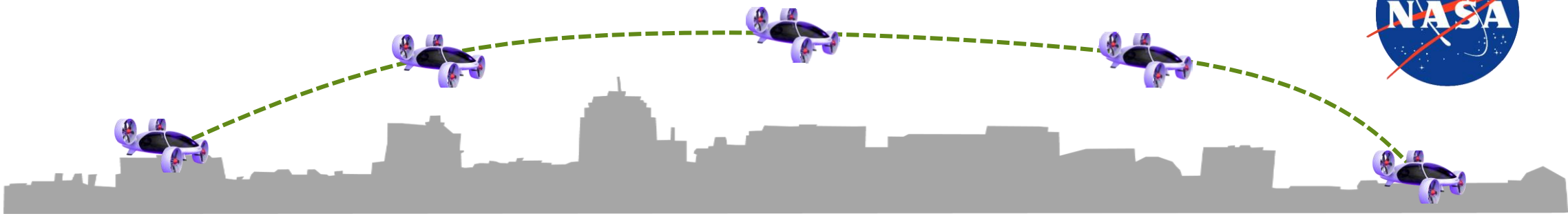
"Vision ConOps"

- High-level – Providing a vision of key concepts in the future
- Broad covering all pillars

Scope

- Passenger-carrying operations
- Vision at the Intermediate state (UML-4)
- Placing air mobility within reach of the general public (i.e., realistic / cost effective transportation choice for general public)

UAM Nominal Gate-to-Gate Operations Overview



	Pre-Flight	Take-off	Climb & Cruise	Descend	Land/De-Plane
Operator	• Request performance authorization • File operations plan • Confirm vehicle ready for departure	• Approves taxi/takeoff authorization and execute take-off	• Conformance monitoring • Vehicle monitoring • Maintain open data exchange with U4-PSU and vehicle	• Conformance monitoring • Vehicle monitoring • Maintain open data exchange with U4-PSU and vehicle	• Conformance monitoring • Ready for turnaround
U4-PSU	• Initiate take-off planning	• Transmit taxi/takeoff authorization and departure sequencing command	• Conformance monitoring • Communicate updated operations plan • Maintain open data exchange	• Conformance monitoring • Communicate and sequencing of route changes, issues landing clearance	• Confirm all clear for vehicle landing
FAA	• Automated Operations Plan approval (through data exchange)	No active participation but maintain authority over airspace			
Vertiport Operator	• Screen passengers & cargo • Perform vehicle boarding • Confirm all clear for departure	• Confirm all clear for vehicle departure	• N/A	• Confirm vertiport clear for vehicle landing • Allocate landing pad	• Confirm landing area is clear • Deplane vehicle
Vehicle	• Perform systems check • Confirm ready for departure	• Execute take-off procedure and sequencing	• Execute climb & cruise procedures • Maintain vehicle-to-vehicle performance-based separation • Monitor systems & push vehicle health and status to operator	• Execute descent procedure and sequencing • Maintain vehicle-to-vehicle performance-based separation	• Scan and confirm all clear for landing • Execute landing

UAM operations are highly collaborative & rely on constant information exchange between stakeholders

Discussion Ground Rules

We will be utilizing the microphone and chat features on the MS Teams platform.

- Leave your cameras/webcams off to preserve WiFi bandwidth
- Enter comments/questions in the chat function on the right side of the screen
- Use your mute/unmute button
- Type "REQUEST TO SPEAK: [Insert First & Last Name]" in the chat box to notify the emcee that you would like to verbally comment/ask a question
- Say your name and affiliation before you begin speaking
- Speak loudly and clearly
  - You will be given up to **90 seconds (1.5 minutes)** to verbally comment/ask a question
- Be professional in all verbal and written comments/questions

Backup

Advanced Air Mobility (AAM) Mission

Image Source: NASA AAM Ecosystem Working Group Kickoff

Develop validated AAM System Architectures that define a safe, certifiable, and scalable system

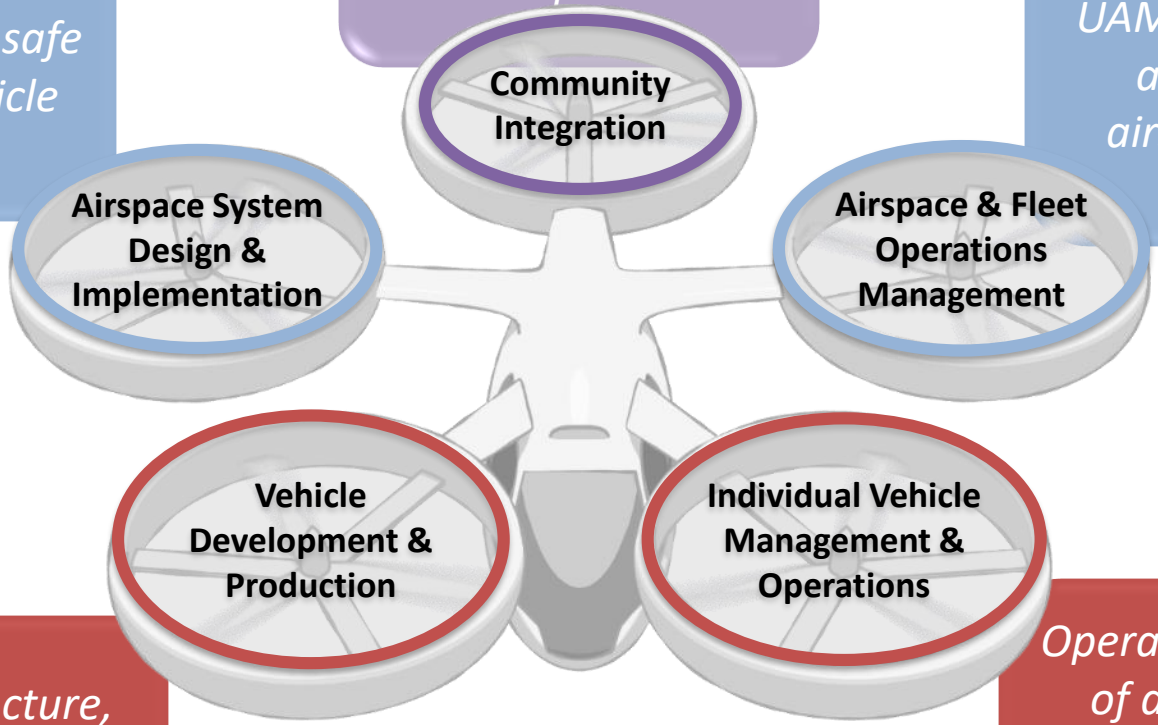
UAM Vision and Framework

Urban Air Mobility (UAM) Vision: Revolutionize mobility around metropolitan areas by enabling a safe, efficient, convenient, affordable, and accessible air transportation system for passengers and cargo

Design, development, and implementation of infrastructure to enable safe and efficient multi-vehicle UAM operations

Societal integration and acceptance of UAM operations

Operations and management of multiple vehicles within a UAM system that enable safe and efficient sharing of airspace and other system resources

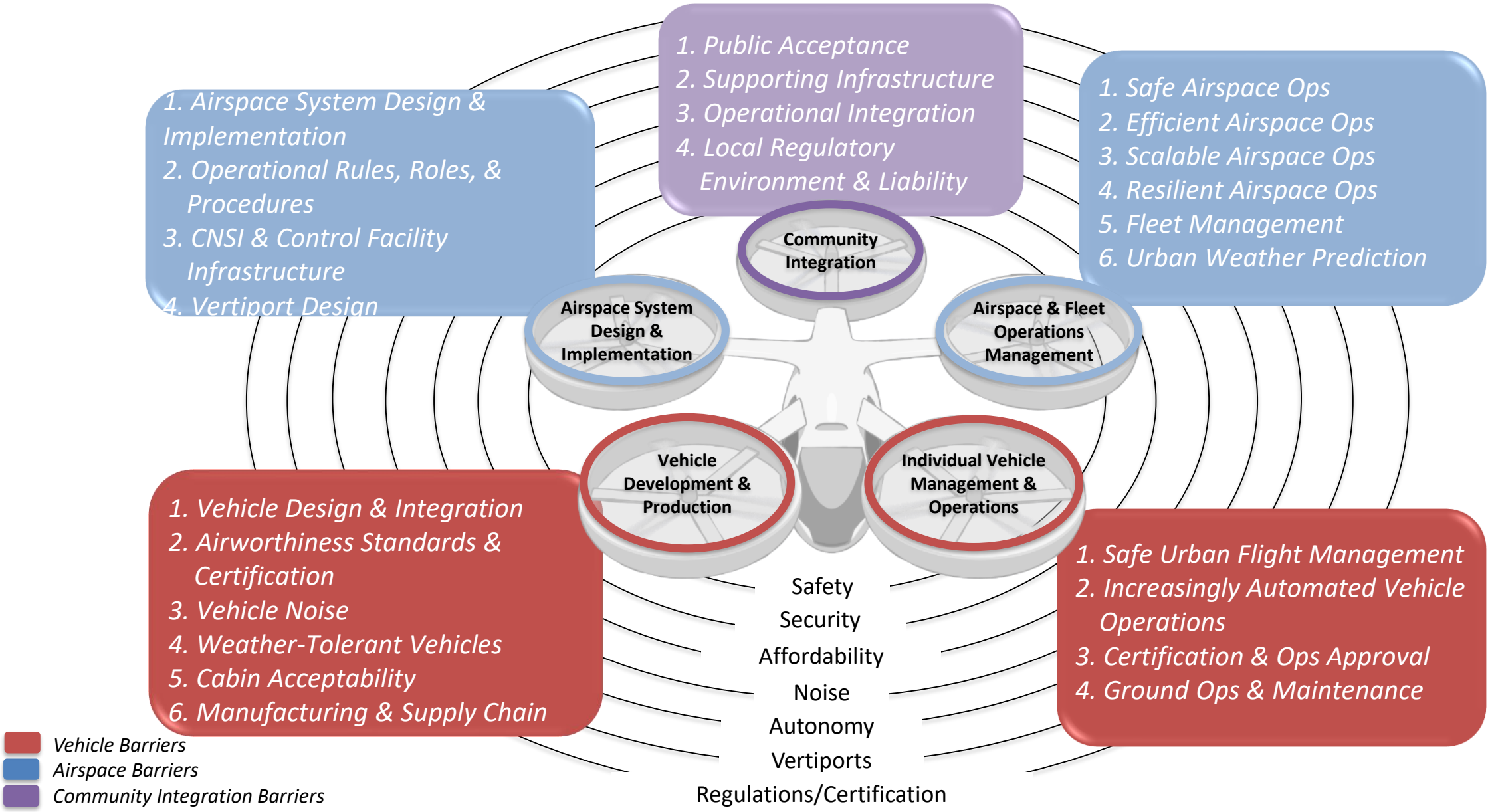


Design, manufacture, and system readiness of UAM vehicles

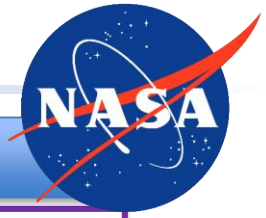
Operations and maintenance of a single UAM vehicle, independent of the sharing of airspace or other system resources

Vehicle Barriers
Airspace Barriers
Community Integration Barriers

UAM Framework and Barriers



UAM Maturity Levels (UML)



UAM Framework and Barriers

	Vehicles	Airspace	Community
INITIAL STATE — UML-1	**Late-Stage Certification Testing and Operational Demonstrations in Limited Environments** Aircraft certification testing and operational evaluations with conforming prototypes; procedural and technology innovation supporting future airspace operations (e.g. UTM-inspired); community/market demonstrations and data collection		
INITIAL STATE — UML-2	**Low Density and Complexity Commercial Operations with Assistive Automation** Type certified aircraft; initial Part 135 operation approvals; limited markets with favorable weather and regulation; small UAM network serving urban periphery; UTM Construct and UAM routes supporting self-managed operations through controlled airspace		
INTERMEDIATE STATE — UML-3	**Low Density, Medium Complexity Operations with Comprehensive Safety Assurance Automation** Operations include urban core; operational validation of advanced airspace operations and management including UTM inspired ATM, CNSI, C^2, and automation for scalable, weather-tolerant operations; few high-capacity vertiports; noise compatible with urban soundscape; model-local regulations		
INTERMEDIATE STATE — UML-4	**Medium Density and Complexity Operations with Collaborative and Responsible Automated Systems** 100s of simultaneous operations; expanded networks including closely-spaced high throughput vertiports; many UTM inspired ATM services available, simplified vehicle operations for credit; low-visibility operations		
MATURE STATE — UML-5	**High Density and Complexity Operations with Highly-Integrated Automated Networks** 1,000s of simultaneous operations; large-scale, highly-distributed networks; high-density UTM inspired ATM; autonomous aircraft and remote, M:N fleet management; high-weather tolerance including icing; high-volume manufacturing		
MATURE STATE — UML-6	**Ubiquitous UAM Operations with System-Wide Automated Optimization** 10,000s of simultaneous operations (capacity limited by physical infrastructure); ad hoc landing sites; noise compatible with suburban/rural operations; private ownership & operation models enabled; societal expectation		

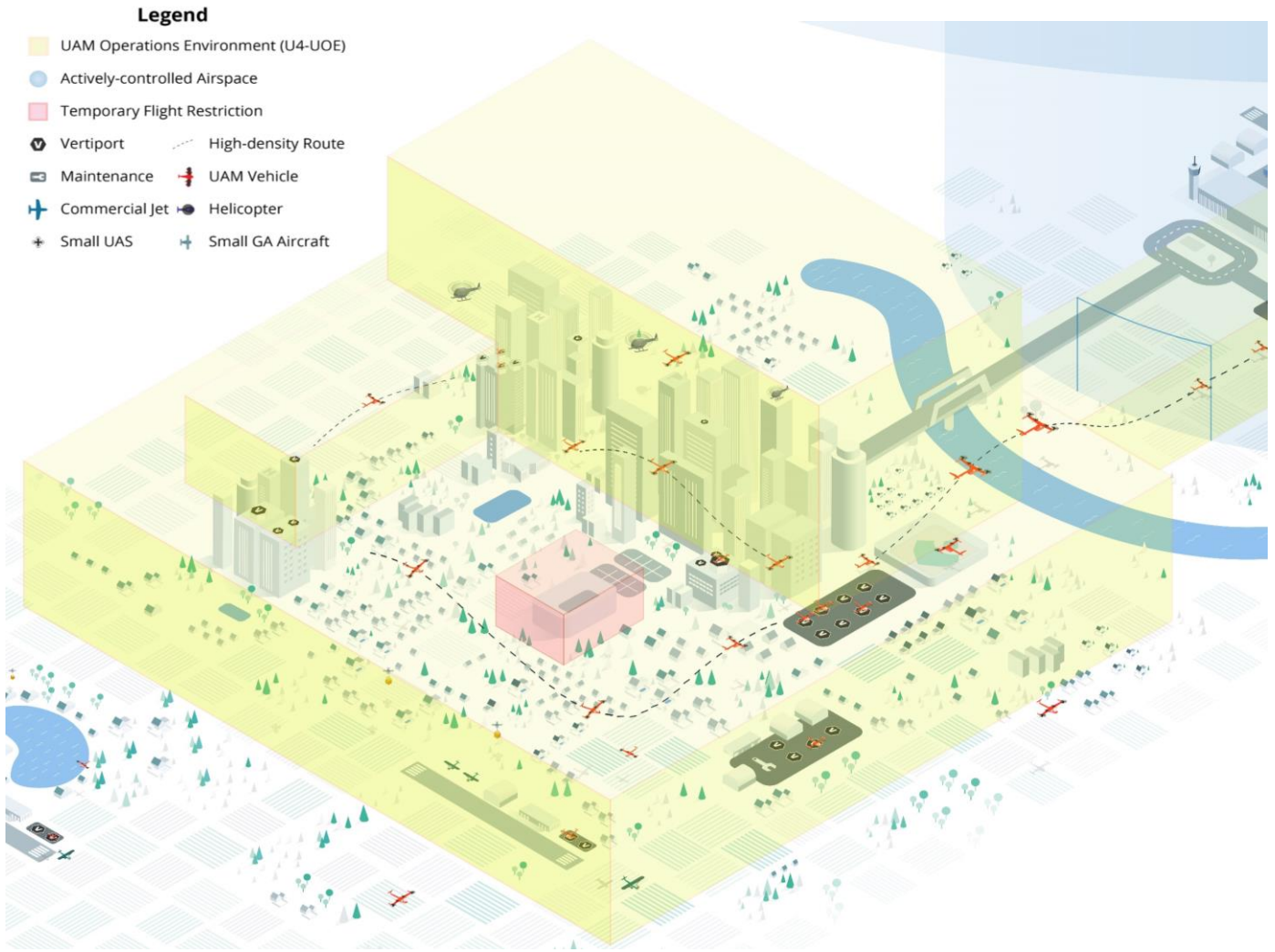
Key Elements of Airspace at UML-4

UAM Maturity Level (UML)-Level 4 : Medium Density and Complexity Operations with Collaborative and Responsible Automated Systems

- U4 UAM Operations Environment (U4-UOE) – Dynamic airspace volumes with high UAM activity
- U4 Provider of Services to UAM (U4-PSU) – Federated 3rd party suppliers of services including air traffic management

Other Characteristics

- Advanced automation (vehicles and air traffic management) largely human over the loop
- High performance vehicles (e.g., EVTOL)) capable of detect and avoid and performance based separation
- All vehicles operating in U4-UOE are appropriately equipped and actively participate in U4-UOE
- U4-UAM is characterized by medium density operations between closely-spaced, high throughput vertiport
- Higher throughout combined with lower operating costs reduce per passenger price & place air travel within reach of the general public as a practical mode of transportation)



Key UAM Elements of Vehicles at UML-4

Advanced **technologies** enable:

- New vehicle configurations
- High performance aircraft
- Efficient propulsion systems
- Greater weather tolerance
- Greater design and production agility

Advanced design and engineering methods (model-based, digital engineering, etc.) along with advanced rapid testing enable more rapid commercialization

Certification process are adapted for new technologies, materials, vehicles and manufacturing process building on the regulatory frameworks in place and enable more rapid incorporation of safety improvements

Mature manufacturing and supply chains, including secure digital processes to track parts and ensure authenticity and traceability, **will enable rapid ordering and receipt of parts**

Key UAM Elements of Community Integration at UML-4

U4-UAM is a value added, **integrated component of a city/region's multi-modal transportation system** and is part of local/regional transportation plans

Cohesive federal, state, and local roles and authorities support design and development of air and ground UAM infrastructure

Effective processes established to engage and consider community integration concerns (e.g., Safety / Noise Visual / Privacy)

Infrastructure meets industry standards, local ordinances and other regulations

Infrastructure integrates advanced technologies to support UAM operations (e.g., grid/power capacity, security, ground transportation, weather sensing, and navigational infrastructure)